ATTACHMENT 6
ROG and NO_X Emissions
Agricultural Burning
San Joaquin Valley

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Waste Burning and Disposal

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
670-660-0262-0000 (47241) Agricultural Burning – Prunings

670-662-0262-0000 (47258) Agricultural Burning – Field Crops

METHOD FOR CALCULATING EMISSIONS

Emissions in this source category come from the open burning of agricultural residues such as crop stubble and orchard prunings. Emissions are calculated by the type of material burned from information supplied to the district when agricultural burn permits are issued. This information includes the type and amount of material to be burned, where the burn will occur, and the day of the burn. The district calculates emissions by multiplying the amount of material burned by a crop-specific emission factor. The amount of material burned is usually reported in acres, which is then converted to tons of material using a fuel loading factor specific to each crop. Emissions are then summed for each county.

Many of the emission factors used to calculate agricultural burning emissions are based on measurements conducted at the University of California at Davis in 1992 and 1993. When these more recent data are not available for specific materials burned, default emission factors are used from the U.S. EPA's "Compilation of Air Pollutant Emission Factors," which is often referred to as AP-42. These emission factors are based on ARB sponsored tests performed in 1974 and 1977. Attachment A lists the emission factors.

ROG and NO_X EMISSIONS IN THE SAN JOAQUIN VALLEY

ROG and NO_X agricultural burning emissions are shown below for a typical summer day. However, on days when ozone or particulate matter concentrations are high, typically a no-burn day would likely be declared, therefore no burning would occur on those days. In addition to the open field burning emissions shown here, roughly 400,000 and 500,000 tons of agricultural materials were burned in biomass facilities in the San Joaquin Valley (SJV) for the years 2000 and 2001, respectively.

Some of the largest sources of agricultural burning emissions in the SJV are grape stump and stake burning, general orchard removal burning, vineyard removal, burning almond prunings, tumbleweed burning, and then, to a smaller extent, other items such as walnut prunings, rice, grape vines, wheat, asparagus, weeds, figs, and other commodities.

The tables below summarize San Joaquin Valley agricultural burning emissions. It is important to note that these values are based on annual average estimates, subdivided to provide average daily summer emissions (May through October). The values shown do not represent the amount of emissions from burning that occur on a specific day. In some cases, all of the emissions for a category may occur over a period of only a few days. Alternatively, in other situations, the burning may occur more consistently throughout the year. Figures at the end of this document show the monthly acreage burned in 2002 for each crop.

Summer ROG Emissions (tons per day)

Category	**2002**	**2010**
Ag Burning – Prunings	4.5	4.3
Ag Burning - Field Crops	3.1	3.0
TOTAL	**7.6**	**7.3**

Summer NO_X Emissions (tons per day)

Category	**2002**	**2010**
Ag Burning – Prunings	4.0	3.8
Ag Burning - Field Crops	1.5	1.4
TOTAL	**5.5**	**5.2**

GROWTH AND CONTROL ASSUMPTIONS

Growth – Irrigated agricultural acreage projections from the Department of Water Resources (DWR) are used as the growth surrogate for agricultural burning. The projected overall decline in the SJV irrigated agricultural acreage is -0.3% per year, which agrees with anecdotal evidence provided through discussions with county agricultural commissioners and other agricultural experts. A more detailed discussion of the basis for the use of this proposed growth surrogate for agricultural pesticides, as well as some of the other agricultural categories, is provided in the separate ARB document "Forecasting Air Pollution Emissions from Agricultural Operations in the San Joaquin Valley" dated May 20, 2003.

Control – No control is applied to the agricultural burning category.

Agricultural Burning Growth Factors

Year	Prunings	Field Crops
1999	1.000	1.000
2000	0.997	0.997
2001	0.994	0.994
2002	0.991	0.991
2003	0.988	0.988
2004	0.985	0.985
2005	0.982	0.982
2006	0.979	0.979
2007	0.976	0.976
2008	0.973	0.973
2009	0.970	0.970
2010	0.967	0.967

TEMPORAL ACTIVITY

The temporal activity is assumed to occur seven days a week, with uniform activity on weekdays and reduced activity on Saturdays and Sundays. Hourly activity is assumed to occur during daylight hours at varying levels. The highest hourly activity is typically from 9 a.m. to 5 p.m. with less chance in the early morning and late evening.

The tables below show how the emissions for burning of prunings and field crops are distributed by month (percent activity) for each county in the San Joaquin Valley. These distributions were developed using the burn dates from the agricultural burn permits submitted to the air district. Although there are wide monthly variations, the burning of prunings generally occurs more in the winter months and field crops in the summer and fall. For estimating summer emissions, the monthly activity is summed for the months of May through October.

The tables and graphs that follow show the acreage burned for various crops and when they are burned, by month. Data is provided separately for field crops, prunings, weeds and other agricultural wastes. Note that each graph has a different scale due to the wide variations in the acreages burned. The final graph is a composite of all of the agricultural burning sources.

Monthly Activity for Prunings (percent)

County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fresno	11.2	9.6	10.6	4.5	3.2	3.2	6.1	5.0	6.2	6.3	22.0	12.2
Kern	11.8	8.1	4.9	6.4	1.5	0.8	0.6	2.0	7.0	3.0	30.6	23.4
Kings	4.8	6.2	14.9	19.0	2.9	1.9	1.8	4.0	8.8	4.2	17.2	14.3
Madera	11.6	16.1	15.7	5.6	3.6	2.1	2.0	1.9	1.4	2.3	25.8	11.9
Merced	16.5	13.9	10.2	5.7	3.6	3.8	4.5	2.7	1.1	2.6	15.5	20.0
San Joaquin	12.4	6.7	11.4	7.0	3.2	8.9	4.2	3.0	2.3	2.6	17.0	21.3
Stanislaus	14.4	12.2	15.6	6.6	3.5	3.3	2.6	1.8	1.4	2.4	17.3	18.8
Tulare	7.3	6.3	17.1	10.7	6.2	2.7	4.8	5.3	7.5	6.1	16.4	9.6

Monthly Activity for Field Crops (percent)

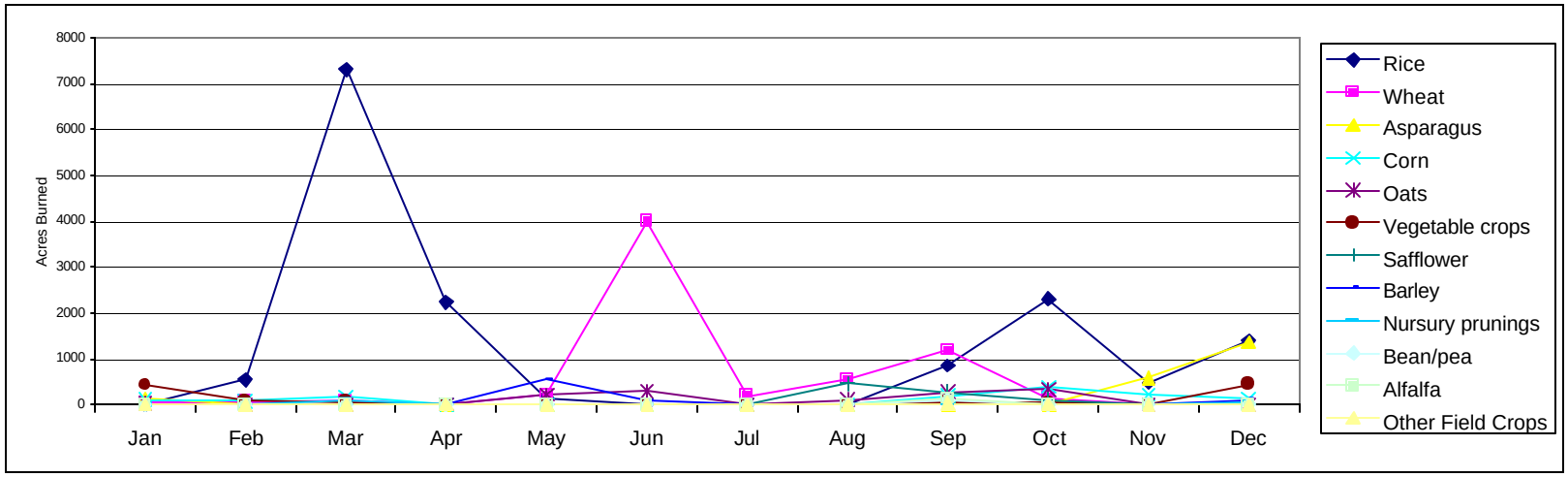
County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fresno	0.0	0.3	22.5	0.4	0.0	0.9	6.4	0.7	17.7	40.5	5.0	5.6
Kern	1.0	0.0	0.0	0.0	1.8	34.4	29.9	3.5	10.0	14.8	3.7	0.9
Kings	0.5	0.0	0.2	0.0	0.0	0.0	75.3	22.6	1.0	0.0	0.4	0.0
Madera	0.3	0.0	0.0	0.0	0.0	10.3	39.1	0.0	1.5	18.5	26.0	4.3
Merced	0.7	0.0	16.5	0.2	1.1	9.8	6.2	1.8	8.3	37.5	17.4	0.4
San Joaquin	0.9	4.0	12.0	25.5	1.1	3.9	7.4	2.2	4.2	15.3	20.0	3.6
Stanislaus	0.0	0.1	55.0	16.7	3.9	2.8	0.3	0.4	0.6	3.1	15.1	2.1
Tulare	0.5	0.0	1.1	0.0	1.8	13.9	31.3	5.9	10.1	14.0	18.3	3.1

FUTURE IMPROVEMENTS

The San Joaquin Valley Unified APCD (SJVUAPCD) recently hired a new staff person who is recalculating the agricultural burning emissions from 1997 through 2000 using the latest emission factors available. The SJVUAPCD is also developing methods of using geographic information systems (GIS) to better track the locations of agricultural burning. In addition, the district is in the process of implementing an advanced automated phone-based system to better manage agricultural burning in the SJV.

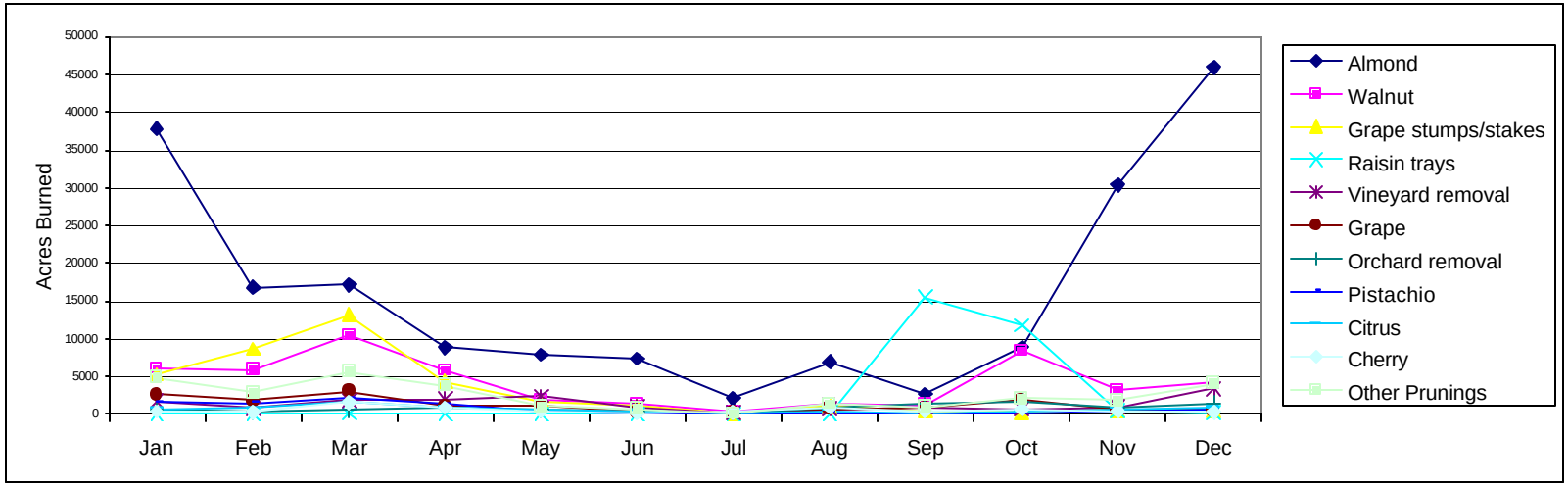
Field Crops – Acres Burned by Month

	Field Crops SJVU Air District - Acres Burned 2002												
Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rice	0	550	7317	2246	162	0	0	0	867	2310	481	1403	15336
Wheat	54	65	103	7	231	3997	200	568	1194	155	0	20	6593
Asparagus	140	0	0	0	0	0	0	0	5		600	1370	2115
Corn	125	80	171	5	0	0	0	0	200	400	221	147	1349
Oats	25	0	0	12	226	303	0	119	292	335	7	5	1323
Vegetable crops	443	104	69	17	3	1	0	18	76	39	24	462	1254
Safflower	0	0	0	0	0	0	0	468	285	118	0	0	871
Barley	0	0	0	0	545	87	16	8	30	0	0	110	797
Nursery prunings	14	8	122	5	2	2	0	1	7	27	22	74	284
Bean/pea	6	2	0	0	0	0	0		110	2	25	20	165
Alfalfa	0	6	0	2	1	0	0	2	143	1	0	0	155
Other Field Crops	12	1	5	13	1	2	0	0	31	21	0	2	89



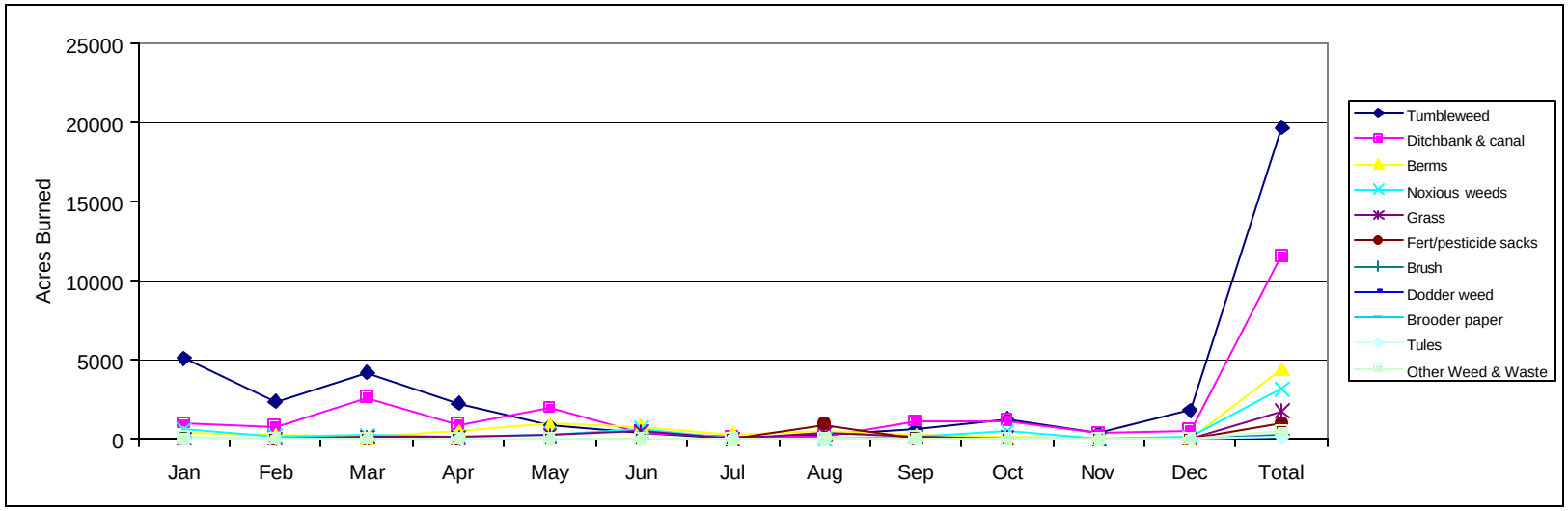
Prunings – Acres Burned by Month

	Prunings SJVU Air District - Acres Burned 2002												
Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Almond	37788	16767	17141	8781	7871	7367	2077	6980	2711	8906	30356	45979	192726
Walnut	6070	5923	10483	5790	1880	1309	345	1431	1198	8382	3229	4148	50190
Grape stumps/stakes	5304	8656	13096	4295	1699	1089	41	1046	405	243	591	418	36882
Raisin trays	17	7	113	7	7	19	0	58	15512	11761	413	217	28128
Vineyard removal	1740	838	1861	2032	2412	1005	190	662	865	649	960	3410	16625
Grape	2674	1806	3050	1131	1101	272	152	691	809	1930	616	564	14795
Orchard removal	621	305	492	926	507	373	124	854	1401	1690	917	1453	9661
Pistachio	1538	1514	2100	1338	446	110	3	155	35	41	470	681	8430
Citrus	716	773	1549	877	501	449	36	418	228	342	747	931	7566
Cherry	386	283	1615	926	370	116	277	890	474	711	443	267	6757
Other Prunings	4848	2858	5656	3835	1083	749	73	1427	955	2075	1813	4060	29432


Acres Burned
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Almond
Walnut
Grape stumps/stakes
Raisin trays
Vineyard removal
Grape
Orchard removal
Pistachio
Citrus
Cherry
Other Prunings

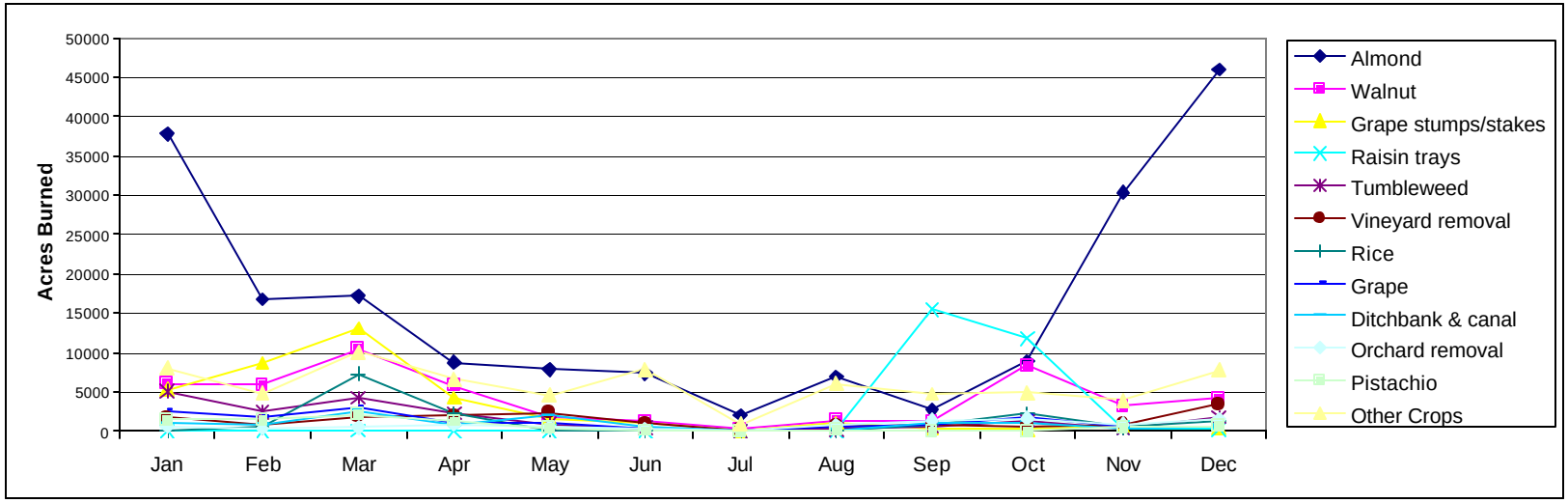
Weeds and Other Agricultural Waste – Acres Burned by Month

	Weeds and Other Ag Waste SJVU Air District - Acres Burned 2002												
Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tumbleweed	5098	2418	4227	2265	922	405	2	245	598	1308	365	1856	19709
Ditchbank & canal	1025	845	2650	956	1986	466	151	196	1141	1184	399	584	11584
Berms	419	272	126	520	983	842	311	588	228	114	2	41	4444
Noxious weeds	606	202	240	174	344	685	18	26	149	503	49	152	3150
Grass	45	60	146	121	263	490	14	399	150	74	10	30	1804
Fert/pesticide sacks	0	1	0	3	9	1	0	950	1	0	0	0	966
Brush	9	7	88	17	11	49	0	0	2	0	1	41	225
Dodder weed	0	0	0	0	13	59	6	95	12	11	0	11	208
Brooder paper	0	0	37	0	33	0	0	13	100	7	0	17	207
Tules	0	30	52	51	0	2	0	0	6	0	0	0	141
Other Weed & Waste	145	64	67	36	25	21	1	34	72	21	13	45	545



All Agricultural Burning – Acres Burned by Month

	All Agricultural Burning SJVU Air District - Acres Burned 2002												
Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Almond	37788	16767	17141	8781	7871	7367	2077	6980	2711	8906	30356	45979	192726
Walnut	6070	5923	10483	5790	1880	1309	345	1431	1198	8382	3229	4148	50190
Grape stumps/stakes	5304	8656	13096	4295	1699	1089	41	1046	405	243	591	418	36882
Raisin trays	17	7	113	7	7	19	0	58	15512	11761	413	217	28128
Tumbleweed	5098	2418	4227	2265	922	405	2	245	598	1308	365	1856	19709
Vineyard removal	1740	838	1861	2032	2412	1005	190	662	865	649	960	3410	16625
Rice	0	550	7317	2246	162	0	0	0	867	2310	481	1403	15336
Grape	2674	1806	3050	1131	1101	272	152	691	809	1930	616	564	14795
Ditchbank & canal	1025	845	2650	956	1986	466	151	196	1141	1184	399	584	11584
Orchard removal	621	305	492	926	507	373	124	854	1401	1690	917	1453	9661
Pistachio	1538	1514	2100	1338	446	110	3	155	35	41	470	681	8430
Other Crops	7994	4815	10045	6620	4645	7856	953	6025	4751	4956	3976	7803	70440


Acres Burned
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Almond
Walnut
Grape stumps/stakes
Raisin trays
Tumbleweed
Vineyard removal
Rice
Grape
Ditchbank & canal
Orchard removal
Pistachio
Other Crops

ATTACHMENT A

Emission Factors for Open Burning of Agricultural Residues

Crop	NOx (lb/ton)	VOC (lb/ton)	Source of Data
Row Crops			
Alfalfa	4.5	21.7	NOx-1992/93;VOC-1974/77
Barley	5.1	15.0	1992/93
Corn	3.3	6.6	1992/93
Oats	4.5	10.3	NOx-1992/93;VOC-1974/77
Rice	5.2	4.7	1992/93
Safflower	4.5	14.8	NOx-1992/93;VOC-1974/77
Sorghum	4.5	5.1	NOx-1992/93;VOC-1974/77
Wheat	4.3	7.6	1992/93
Orchard and Vine Crops			
Almond	5.9	5.2	1992/93
Apple	5.2	2.3	NOx-1992/93;VOC-1974/77
Apricot	5.2	4.6	NOx-1992/93;VOC-1974/77
Avocado	5.2	18.5	NOx-1992/93;VOC-1974/77
Bean/Pea	5.2	14.2	NOx-1992/93;VOC-1974/77
Cherry	5.2	6.0	NOx-1992/93;VOC-1974/77
Citrus	5.2	6.8	NOx-1992/93;VOC-1974/77
Date palm	5.2	3.8	NOx-1992/93;VOC-1974/77
Fig	5.2	6.0	NOx-1992/93;VOC-1974/77
Grape	5.2	3.8	NOx-1992/93;VOC-1974/77
Nectarine	5.2	2.3	NOx-1992/93;VOC-1974/77
Olive	5.2	10.3	NOx-1992/93;VOC-1974/77
Orchard	5.2	6.3	1992/93; 1974/77
Peach	5.2	3.0	NOx-1992/93;VOC-1974/77
Pear	5.2	5.1	NOx-1992/93;VOC-1974/77
Prune	5.2	4.6	NOx-1992/93;VOC-1974/77
Walnut	4.5	4.8	1992/93